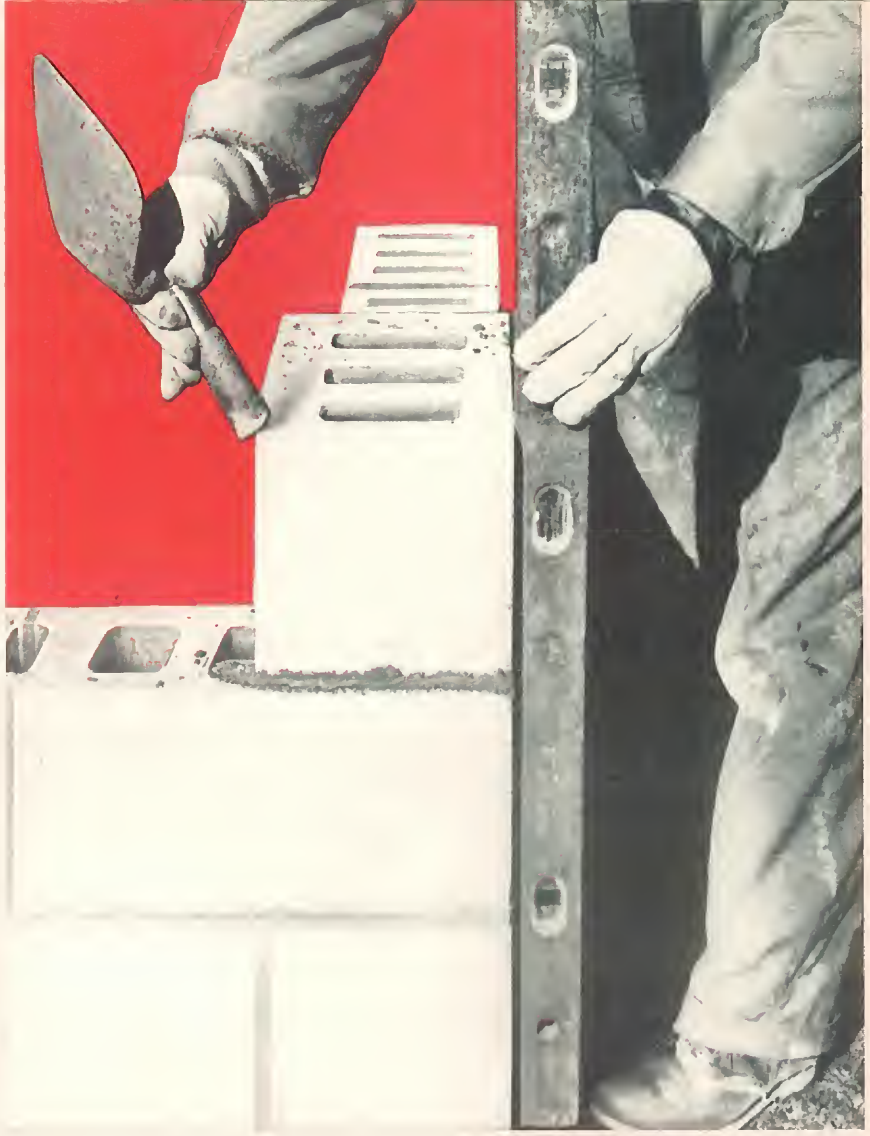


Build BETTER MASONRY with Atlas Mortar Cement

A. I. A. FILE No. 3-A-9

Contents

THE 3 ESSENTIALS TO

Better Masonry

Good masonry is of direct concern to the building profession.

GOOD DESIGN, the first essential to good masonry, is primarily the concern of the architect or engineer. This is a subject in itself and for the purpose of our discussion here, good design is assumed.

GOOD WORKMANSHIP, the second essential to good masonry, is no less important. This is the concern of the contractors who undertake to build the designers' plans. Herein, we mention briefly some principles of good workmanship relating to masonry construction.

GOOD MATERIALS is the third important essential to good masonry. It is the main purpose of this booklet to discuss good masonry materials in general, and, in particular, a good masonry cement—Atlas Mortar.

4 ESSENTIALS TO Better Mortar

GOOD MORTAR CEMENT Atlas Mortar Cement provides masonry craftsmen with a material worthy of their skill. Most masons take pride in their skill and craftsmanship and, consequently, they prefer to work with first-class tools and materials. Atlas Mortar Cement is a recognized aid to good workmanship and provides all of the characteristics required for good masonry mortar in a single cementing material.

GOOD SAND Good, clean, well-graded sand, as specified on page 8, is a very important contribution to mortar quality. Sands deficient in fines (passing a No. 50 and No. 100 mesh) usually make harsh mortars, leading to poor workability and bonding characteristics. An excess of fines, on the other hand, requires excessive mixing water which reduces strength. Where fines are excessive, adding more masonry cement to compensate for strength loss may result in increased shrinkage.

GOOD WATER The water used in mixing mortar should be clean enough to drink. Enough mixing water should be used to produce the desired consistency.

PROPER MIXING Thorough mixing is necessary to produce mortars of maximum workability and yield. It also promotes uniformity of batches. In hand-mixed batches, time of mixing must be judged by the man mixing it, and time taken to mix mortar properly is well spent. Machine-mixed batches are preferred where possible, and should be mixed for three minutes—four is better—but *never* less than two minutes.

What is Atlas Mortar Cement?

Atlas Mortar Cement is a prepared masonry cement specifically developed to produce a superior mortar for general masonry use. Because of its excellent plasticity and water-retaining characteristics, it provides exceptional workability and bonding properties which are all important mortar qualities to masons and masonry contractors. It further provides good yields and the setting and hardening properties which are also desired by them.

In addition, Atlas Mortar Cement provides the important service characteristics of strength, durability and good color valued by architects, engineers and builders. Atlas Mortar Cement provides all these qualities in one cementing material. It is easy to handle, and only sand and water need to be added to mix the mortar.

COMPOSITION OF ATLAS MORTAR CEMENT

What's in Atlas Mortar Cement that makes it better? A fair question. In addition to the purely material ingredients that go into Atlas Mortar Cement during its manufacture, is the equally important, and perhaps all-important, "human-ingredient"—the skill and ability of those who make it. Atlas Mortar Cement contains this priceless ingredient in full measure, and this accounts for its exceptional merit and quality.

Atlas Mortar Cement is a portland cement base masonry cement composed of skillfully proportioned amounts of portland cement and limestone which are scientifically ground to a fine powder. Interground with Atlas Mortar Cement are precise amounts of gypsum to properly regulate the setting time, and an air-entraining agent for plasticity and durability.

Atlas Mortar Cement well exceeds the requirements of current ASTM and Federal Specifications for both Type I and Type II masonry cements. Type I is intended for use in solid masonry construction above grade that is not exposed to frost action. Type II is intended for general use where mortars for masonry are required.

Typical specification test data for Atlas Mortar Cement is available upon request to any Universal Atlas Sales Office.

ATLAS MORTAR CEMENT *in Brief*

1. *Saves time and effort*
2. *Fewer materials to handle, store, mix*
3. *Easy to mix any amount needed*
4. *Superior plasticity*
5. *Good bonding qualities*
6. *High water-retention*
7. *Stays workable*
8. *Requires less retempering*
9. *Excellent yield*
10. *Requires less supervision*
11. *Sticks to units*
12. *Slips cleanly from trowel*
13. *Holds together*
14. *Less droppage, less waste*
15. *Less cleaning necessary*
16. *Helps masons to do their best work*
17. *Low volume change*
18. *Ample strength*
19. *Resists efflorescence*
20. *Has right "body" for heavy masonry units*

Why Atlas Mortar Cement is BETTER

EFFICIENCY

Good mortar is easier to make with Atlas Mortar Cement. It reduces the number of materials that must be stored, handled and mixed. This makes it easier both to mix and to maintain more uniform mortar batches. When bricklayers and masons are working with a good workable mortar, it is well-known that they can lay up more units and, at the same time, are likely to do their best work. With Atlas Mortar Cement none of the masons' time need be lost in "fighting" a harsh mortar.

ECONOMY

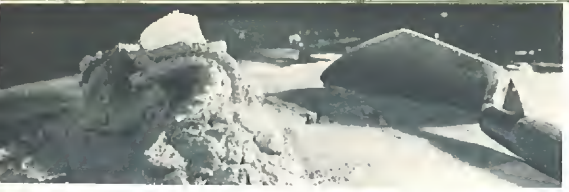
The masons' time is a major item in masonry construction. For this reason, a mortar that is easy to work with, that calls for a minimum of retempering, and that does not have to be pampered to remain workable, will save the masons' time on the job. And since there are fewer materials that must be handled, Atlas Mortar Cement also helps save time on the job. The excellent plasticity and cohesiveness of mixes made with Atlas Mortar Cement help keep the amount of droppage and waste to the minimum. Finished jobs are easier to clean, and less cleaning is needed. Mason contractors and superintendents have reported that the superior plasticity of Atlas Mortar Cement mixes, and the way they hold their workability, are important factors in keeping costs down and help to make the most economical use of masons' time.

QUALITY

Each bag of Atlas Mortar Cement carries with it the earned reputation and full backing of the Universal Atlas Cement Company. It is produced in ten modern, efficiently operated plants located conveniently to important market areas. Into Atlas Mortar Cement, in addition to high-quality raw materials, goes the skill and production know-how that a large, experienced, well-staffed organization can provide. Throughout the many different steps of manufacture, Atlas Mortar Cement is subjected to numerous exacting quality control tests to assure its uniformity and quality of performance. More than that, it is also the subject of constant study in the industry's largest company-owned research laboratories. Working closely with the men in the plants and laboratories are the company's technical service engineers in the field who do their part in contributing to a never-ending study and appraisal of the product's merits under actual field use and conditions. Such extensive examination and re-examination of product quality and performance inevitably has its effect in maintaining and improving the high quality of Atlas Mortar Cement. That is why Atlas Mortar Cement has received wide-spread recognition and acceptance by those who have used it and come to rely upon it.

UNIFORMITY

Atlas Mortar Cement is a quality controlled product. Painstaking and careful attention to product quality during manufacture has produced a more uniform product for the mason. This contributes to uniformity in mortar which helps produce better masonry.



BETTER QUALITY CONTROL

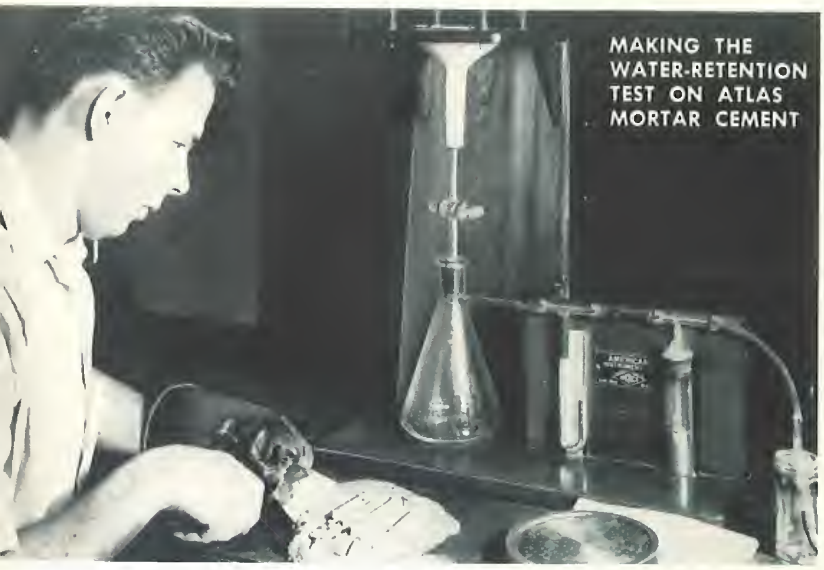
PLASTICITY

In the picture above, note the plastic consistency of mortar made with Atlas Mortar Cement. The way the curl holds together without breaking apart demonstrates the excellent cohesiveness of the mortar.

An Atlas Mortar Cement mix has sufficient plasticity to hold its shape well, but at the same time, it works smoothly with a flick of the trowel. Atlas Mortar Cement "works" superbly and does just what the mason wants it to do, spreading easily under the trowel with satin-smoothness.

In addition to being easy to work, the plasticity of a mortar influences the ultimate bonding between the mortar and units and, therefore, resistance of walls to water penetration. Plasticity is the keystone quality upon which many of the other desirable characteristics of mortar depend and is so important that it will often be referred to in discussing other qualities of Atlas Mortar Cement.

Plasticity is made into Atlas Mortar Cement as are its other desirable properties. Atlas Mortar Cement, when properly mixed, is rated high in smoothness and workability characteristics.



MAKING THE WATER-RETENTION TEST ON ATLAS MORTAR CEMENT

WATER-RETENTION

The ability of a mortar to retain its mixing water when placed on masonry units is of utmost importance. Masonry units of different types vary widely in porosity and absorption. The high suction of absorptive units takes water away from the mortar. Mixes made with Atlas Mortar Cement strongly resist this suction, retain their water, and thus, the possibility of quick stiffening and drying out is greatly reduced.

Because of Plasticity and Water-Retention, Atlas Mortar Cement Mixes:

(a) Stick well to all types of units;

(b) Slip cleanly from the trowel at the flick of the wrist, yet cling just enough to be easy to work with;

(c) Have the consistency, and body, necessary to hold heavy concrete block units in line;

(d) Because of its cohesiveness the curls of mortar forced out from bed and head joint can be recovered. This reduces waste.

YIELD

Atlas Mortar Cement is well-known for its highly satisfactory yield of mortar per bag of cement. Masonry contractors have noted with particular satisfaction the number of units that can be laid up per bag of Atlas Mortar Cement.

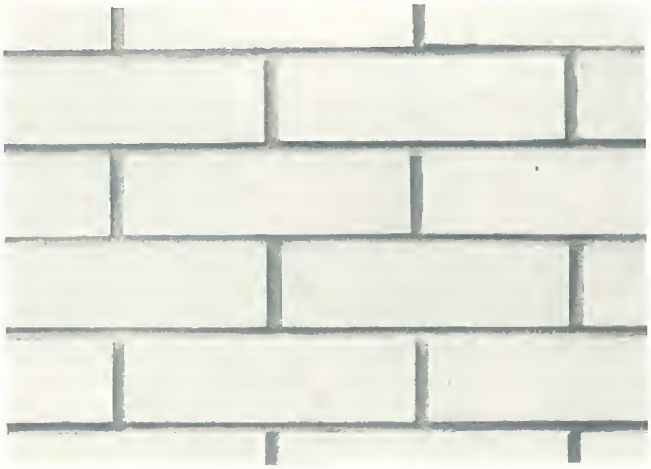
In the language of bricklayers, yield is often referred to as "sand carrying capacity." The physical characteristics of different sands may sometimes require that varying amounts be used to produce mortar with the desired workability. Atlas Mortar Cement is not sensitive to such sand variations, and helps minimize variations in yield. It gives comparably good yields with the various masonry sands. The maximum yield for given mix proportions of Atlas Mortar Cement is obtained by thorough machine mixing.

In most cases, the proportions recommended are 1 bag of Atlas Mortar Cement to 3 cu. ft. of sand. These proportions will give a mortar having satisfactory yield, excellent plasticity, and which will develop all the needed strength, except for very unusual conditions.

in making means BETTER MORTAR in use...

COLOR The color of hardened mortar joints may be of considerable importance to the architectural designer, since they must blend or contrast pleasingly with the masonry units he has chosen. Uniformity of color may be an important and necessary mortar requirement. Atlas Mortar Cement helps to secure uniform mortar color in two ways: (a) it is the only cementing material used in the mortar; (b) its color is controlled during manufacture. It must be pointed out, however, that the color of the mortar is greatly influenced by the color of the sand used. If special color effects are desired, mineral oxides and other suitable coloring pigments may be added.

The frequent choice and specification of Atlas Mortar Cement from test panels made in the field for architects, demonstrates the acceptability of its color.



WATER-TIGHTNESS

Good workmanship is the primary factor in obtaining water-tight joints in masonry structures. Atlas Mortar Cement, however, contributes to water-tightness in several ways. By providing a mortar of excellent working consistency with less mixing water, it helps to minimize shrinkage which may result in separation cracks through which water can enter. The outstanding water-retention and workability retaining characteristics of mortar made with Atlas Mortar Cement also helps to obtain a better bond, and therefore, more water-tight joints.

EFFLORESCENCE

This crystalline material, usually white, is deposited on masonry surfaces when the passage of water through masonry walls transports to the surface water soluble salts which may be present in either masonry units, sand, mortar or mixing water. It can be effectively minimized by water-tight masonry joints made with Atlas Mortar Cement which block the passage of water through masonry.

VOLUME CHANGE

Low Expansion

The cementing materials used in masonry mortar must have low expansion over a long period of time. High expansion in the masonry mortar may produce severe cracking and structural damage in masonry.

The importance of low expansion is recognized in the ASTM and Federal Specifications for masonry cement which include a requirement for soundness as measured by expansion in the autoclave. Quality control tests made during the manufacture of Atlas Mortar Cement assure low expansion, and compliance with these requirements by an ample margin.

Test bars of Atlas Mortar Cement are placed in autoclave and subjected to saturated steam at 420° F; 295 psi.

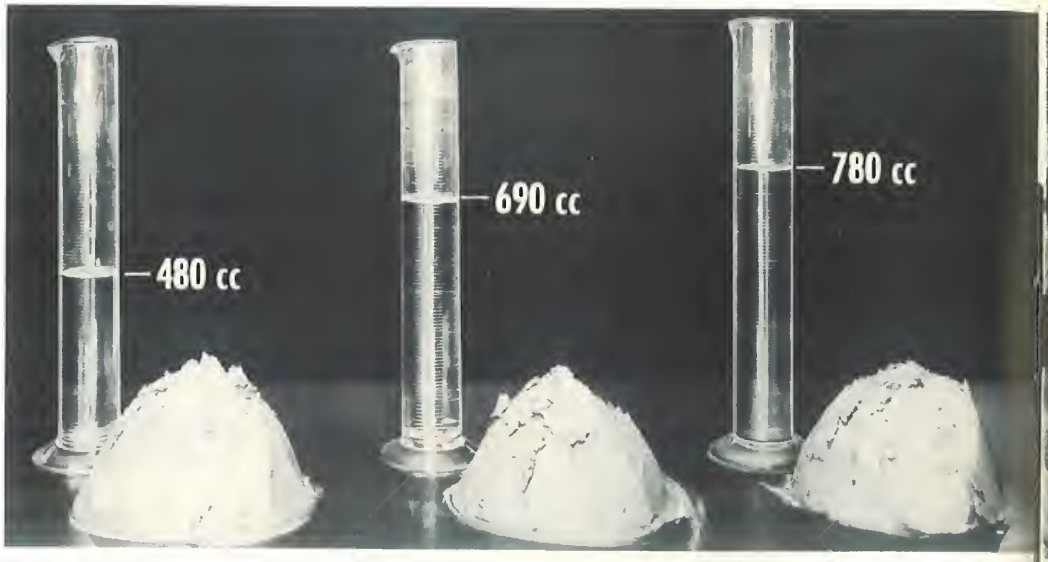
The length is precisely measured to 1/10,000th of an inch before and after autoclaving.

Expansion is calculated. Low expansion of Atlas Mortar Cement is shown by this test.

and Better Mortar means BETTER MASONRY

VOLUME CHANGE
Low Shrinkage

Excessive amounts of water used in mixing or retempering mortar may cause shrinkage cracks in the hardened mortar. Good masonry mortar must have low shrinkage to minimize development of separation cracks between mortar and units. Mortar joints made with Atlas Mortar Cement will have low shrinkage because a minimum amount of mixing water is needed to produce a mortar of excellent working consistency.



1:3 Atlas Mortar Cement Mix requires less water to produce a good working consistency than a . . .

1:1:6 Portland Cement-Lime Mortar Mix with equal volumes of portland cement and lime, or a . . .

1:2:9 Portland Cement-Lime Mortar Mix of 1 part of portland cement to 2 parts of lime.

DURABILITY

Atlas Mortar Cement provides long-lasting resistance to weather and to the destructive effects of alternate freezing and thawing. A precisely determined amount of air-entraining agent is interground during the manufacture of Atlas Mortar Cement. This air-entraining agent results in billions of microscopically small air bubbles being formed and well dispersed through the mortar during mixing. These entrained air bubbles in hardened mortar joints act as tiny expansion chambers that accommodate the pressure from expansion of freezing water within the mortar. In this way, the destructive effects of freezing are prevented.

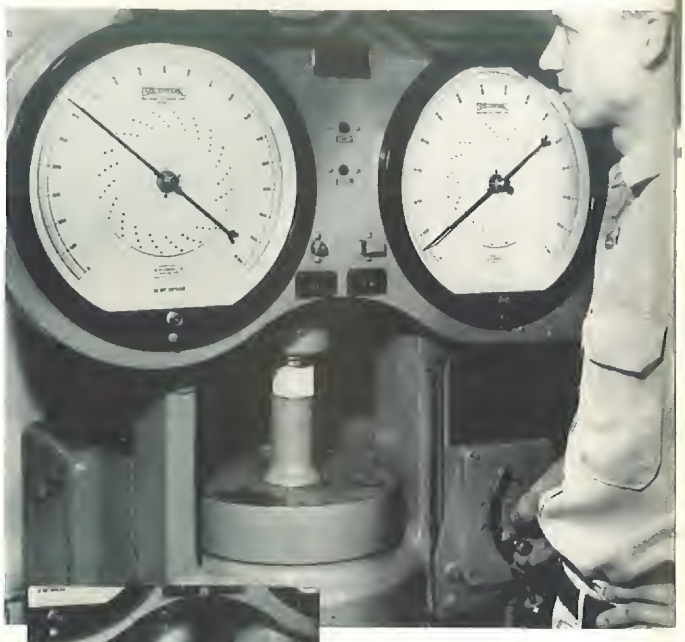
The added durability of mortar joints made with Atlas Mortar Cement minimizes the need for costly repointing work.

STRENGTH

The ultimate strength of hardened masonry mortar is affected by the mix proportions, quality of sand and the amount of mixing water used. Rich mixes, such as 1:2, make stronger mortars. However, for general masonry work a 1:3 proportion of Atlas Mortar Cement to sand is recommended. This will provide a mortar with ample strength for general use.

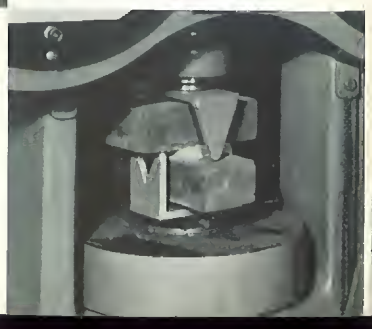
The *ASTM Specifications for Mortar for Unit Masonry, C 270,* contain requirements for compressive strength. These specifications also require that masonry cement conform with *Standard Specifications for Masonry Cement,* ASTM Designation C 91.

Atlas Mortar Cement is manufactured under rigid quality control and conforms with current ASTM and Federal Specifications for masonry cement.



COMPRESSIVE STRENGTH tests (above) are made on 2" cubes of Atlas Mortar Cement. It exceeds by a wide margin ASTM and Federal requirements.

FLEXURAL STRENGTH tests (above) are made in studies of masonry mortars at Universal Atlas Research Laboratories.



BOND STRENGTH tests (right) are also part of a continuous program of research on masonry mortars.

EXTRA Control means EXTRA Performance!

A test batch of Atlas Mortar Cement is given an initial flow test. The mortar is then placed in a specially constructed box (picture 1) and exposed for 30 minutes to 120° F. heat from infra red lamps while a fan vigorously circulates a current of air across it. Such exposure simulates the most severe field conditions. After this exposure period a second flow test is made (pictures 2, 3 & 4). Workability retention is the percentage relationship of the second flow to the first flow. Atlas Mortar Cement has a workability retention value of at least 80 per cent of initial flow.

WORKABILITY RETENTION

The wide acceptance of Atlas Mortar Cement is due not only to its excellent workability, but also to its *workability retention qualities*.

Masons are particularly concerned with the way a mortar handles under the trowel, how much mortar can be spread out before units must be placed, and how long a period the mortar will remain plastic and workable without retempering, especially under adverse weather conditions of hot sun and dry wind.

To get a measure of these desired properties in Atlas Mortar Cement, the Universal Atlas Research Laboratories have developed a workability retention test which simulates job conditions.

All Atlas Mortar Cement passes this exacting test. That is why so many masons find it exceptionally satisfactory in this respect.

Frequently after the foregoing and other quality control tests have been made, a mortar batch is remixed and test brick are laid up to study mortar action and workability under the trowel. This type of painstaking and thorough research results in better Atlas Mortar Cement performance.

FINENESS

Laboratory technician at left checks fineness and uniformity of grinding on test samples of Atlas Mortar Cement. Regularly made as one of the routine quality control tests, this is a typical example of the extra care and attention to fine points of quality control and manufacture that provide Atlas Mortar Cement's "plus" performance qualities in the field.

SETTING

The test shown at right was specially developed in Universal Atlas Research Laboratories to measure setting characteristics of cement. Development of newer and better means for testing product performance in the laboratory well illustrates the importance given to providing better quality control during manufacture, and better performance qualities of Atlas Mortar Cement in field use. Quality control during manufacture is not just a step at Universal Atlas; it is a tradition and a craft.

RECOMMENDED PRACTICE:

SAND

Sands for use in masonry mortar affect workability, strength and durability and should be graded from fine to coarse as shown in the table below. Sand may be either natural or manufactured. Suitability of sand for mortar use varies, and where quality of work, efficiency and economy are important, sand should be checked to comply with the requirements of ASTM Specifications C 144. These specifications include the following requirements for gradation and deleterious substance:

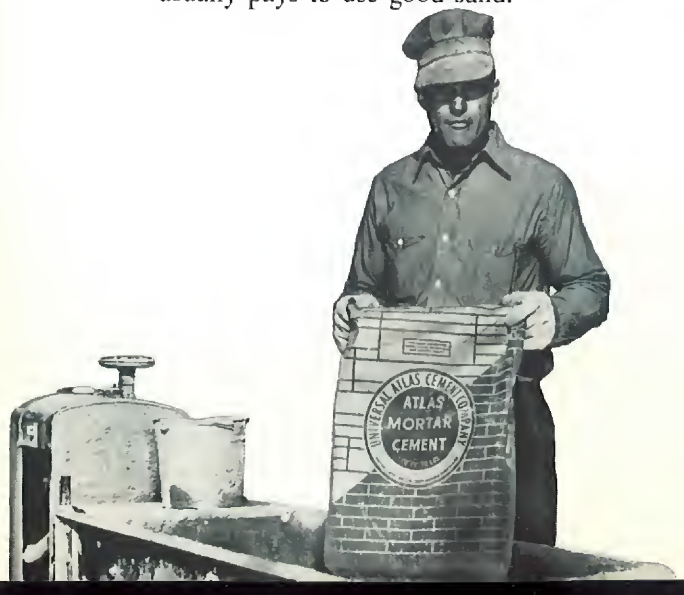
Sieve No.	Per Cent Passing: Natural Sand	Per Cent Passing: Manufactured Sand
4	100	100
8	95-100	95-100
16	60-100	60-100
30	35-70	35-70
50	15-35	20-40
100	2-15	10-25
200	—	0-10

"Maximum permissible percentages by weight of deleterious substance are as follows:

Clay Lumps 1.0
Lightweight particles floating on liquid having a specific gravity of 2.0 . . . . . 0.5[a]

(a) *This requirement does not apply to blast-furnace slag aggregate."*

A good masonry sand should not contain organic materials in injurious amounts. Sand should be tested for organic impurities and rejected if it produces a color darker than the standard. Poorly graded sand may require more cement to get a workable mortar, so it usually pays to use good sand.



WATER

The water used in mixing mortar should be clean and suitable for drinking. Workable mortar should be achieved by thorough mixing rather than the use of an excessive amount of water.

PROPORTIONING

The amount of sand per bag of masonry cement in a mortar mix will affect the workability properties and ultimate strength that the mortar develops. The proportions most often used are 1 part Atlas Mortar Cement to 3 parts of a masonry sand by volume meeting standard requirements, and are generally recommended for mortar that will have the best all round qualities.

The 1:3 proportion produces mortar of excellent workability and plasticity and will also provide adequate strength for most purposes. On jobs where maintaining uniform quality and good yield are of primary importance, sand should be proportioned by weight and proper correction made for free water content since variations in moisture content cause considerable variation in volume measurements due to bulking.

Richer mixes than 1:3 are only to be used for special structural purposes where extra strength is needed. For general use, rich mixes are not economical. When sand is poorly graded and particularly if extremely fine or coarse, it may be necessary to make the mix richer than 1:3 in order to get the desired plasticity. For quality work, however, every effort should be made to obtain masonry sand meeting the specifications given under SAND, above.

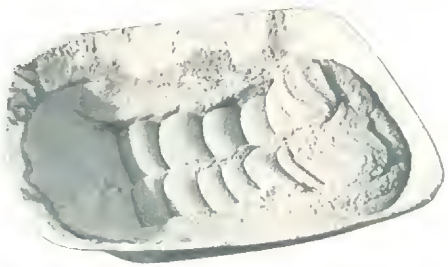
MORTAR PROPORTIONS AND COMPRESSIVE STRENGTH

MORTAR TYPE	PARTS BY VOLUME: ATLAS MORTAR CEMENT	PARTS BY VOLUME: PORTLAND CEMENT	PARTS BY VOLUME: SAND DAMP, LOOSE	AVERAGE COMPRESSIVE STRENGTH AT 28 DAYS, psi
M (A-1)	1	1	4.5 to 6	2500
S (A-2)	1	½	3.4 to 4.5	1800
N (B)	1	. .	2.25 to 3	750

Adapted from Tables I and II of Specifications for Mortar for Unit Masonry, A.S.T.M. Designation: C 270.

MACHINE MIXING

Machine mixing should be used whenever possible. When mixing by machine, start the empty mixer and pour a bucket of water into the mixer to wet the interior. Next, add about half of the sand and then all of the Atlas Mortar Cement, followed by the rest of the sand. Mix for 1 minute, and slowly add the remainder of the water. Mixing should continue for *at least three minutes* after all the materials, including water, are in the mixer. Extra mixing, up to five minutes, pays dividends by improving the mortar characteristics. Thorough mixing results in better workability and water retention.



Excellent mortar plasticity is quite evident in this freshly mixed batch made with Atlas Mortar Cement.

HAND MIXING

The use of the hoe and the mortar box for mixing masonry mortar predates the building of the pyramids. This method is sometimes used today where small amounts of mortar are needed. Machine mixing, however, is preferred and should be used whenever possible. With hand mixing, the sand is measured and spread in the box. Atlas Mortar Cement is then spread on top of the sand. These ingredients are mixed together with a hoe until the dry mixture is thoroughly blended to a uniform color. The mixture is then spread out and about half the required water is added, forming a puddle in the center. Water is worked into the mixture and as the mixing continues, enough water is added to bring the mortar to the desired working consistency when mixing is completed.

RETEMPERING

When a batch of mortar has been exposed to the open air on the mortar board for a prolonged period of time, it begins to stiffen. Workability of batches made with Atlas Mortar Cement can usually be restored by working the mortar with the trowel. When mortar is exposed to a hot sun and drying winds, it will require retempering much sooner than on a cool, cloudy, humid day. After severe exposure, remixing alone may not restore the proper consistency. In such cases, small amounts of water may be added, but the total amount should be kept to a minimum. Proper workability of the mortar should be maintained because of its important effect on development of good bond with the units.

WETTING THE BRICK

Brick with high absorption, if laid dry, will absorb water from the mortar before bond develops. Absorptive brick must be thoroughly wetted before laying to obtain good masonry. There should be no free water on the brick surface when laid.

COLD WEATHER USE

Masonry work can be done successfully in cold weather, if the necessary precautions are taken when temperatures fall below 40°F. Masonry should be protected from freezing for at least 48 hours to avoid impairment of both bond and strength. It is also very important to prevent the masonry from drying too rapidly during this early period.

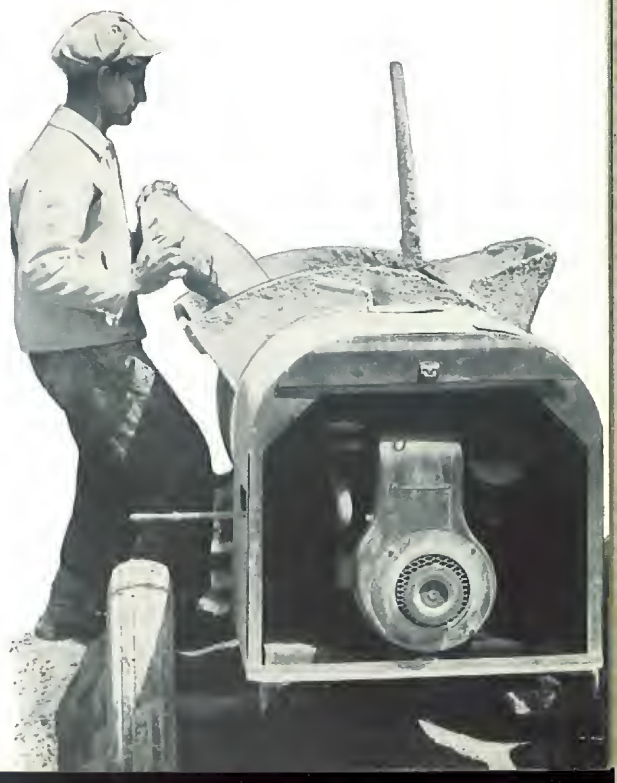
The amount of protection needed depends upon the temperature. Between 40°F. and 32°F. all materials should be covered and properly stored to keep them dry. Mixing water should be heated but not above 160°F. The mortar temperature should be kept above 50°F. Mortar temperature should not become high enough to cause quick stiffening.

In cold weather, it is particularly important that concrete units be stockpiled off the ground; and kept dry and covered. Since most sand contains moisture it must be free of ice before using. Heating sand above 50°F. is seldom necessary and scorching the sand should be avoided.

HOT WEATHER USE

On dry, windy days, especially when it is hot, and there is direct sunlight, mortar batches tend to dry out more quickly. In such weather, mortar should be kept covered if possible, to protect it from premature loss of workability. It is also more important to pre-wet absorptive brick in such weather just before using, but concrete block should not be pre-wet.

It is also good practice under hot, dry weather conditions to mix smaller batches than usual.



WORKMANSHIP

Mortar for bed joints should be spread thickly and uniformly.

• FULL JOINTS FOR BRICK

The first rule of good workmanship in brick masonry construction is to fill all head joints and bed joints completely with mortar.

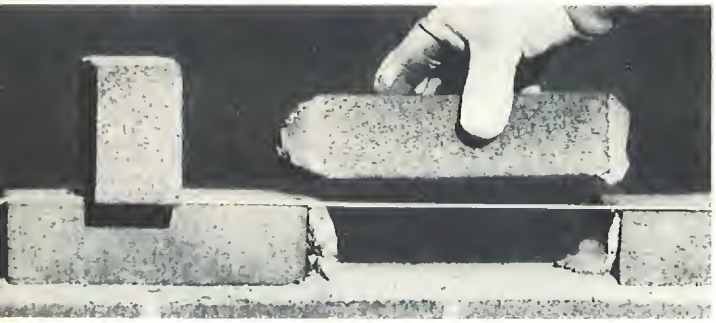
Expert bricklayers "shove" brick into a full bed of mortar so that excess mortar is squeezed out on both sides of the head and bed joints. This assures full vertical and horizontal joints and helps establish a good bond between the brick and mortar. Bed joints should not be "furrowed."

With Atlas Mortar Cement, the mortar for the bed joints can usually be spread over several bricks, but care should be taken to gauge this length to the weather conditions so that the mortar is still soft and plastic when the bricks are bedded. It is a good idea occasionally to lift a brick that has just been bedded to see whether the mortar is properly sticking to the brick.

(Above) The head of the brick is well buttered with mortar before being "shoved" into a full bed.

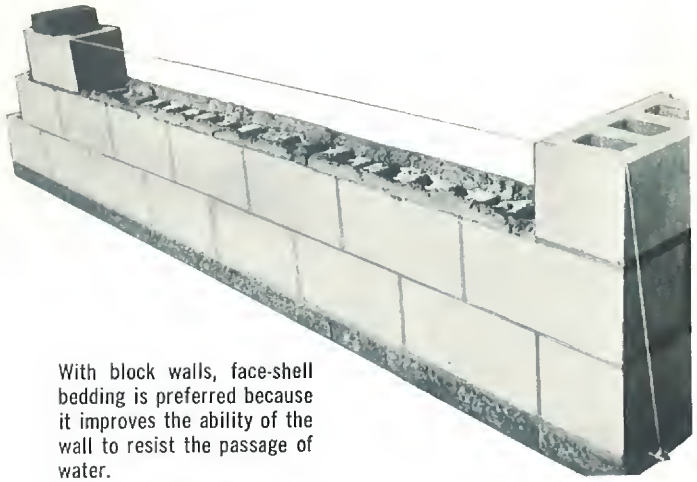
(Right) Brick being placed should be thickly buttered on the end and "shoved" into place. Both the head and bed joints should be completely filled so that excess mortar is squeezed out.

(Below) Before placing the closure brick, mortar should be buttered on the ends of brick already in place. Mortar is also placed on both ends of the closure brick. (Bottom) The closure brick is then pressed into place.



(Below) **Simple Test for Good Bonding**—A quick field check to determine if the mortar is bonding properly to the brick can be made (left) by placing mortar on a brick and pressing another brick onto it until the joint is full and mortar squeezed out. Then (right) pull apart. Mortar should adhere well to both brick as shown. If not, the brick may require wetting or the mortar consistency should be adjusted.

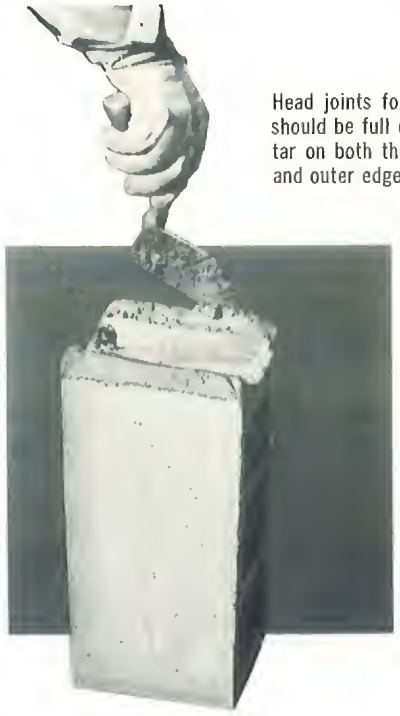
A most important factor in determining the water-tightness of a wall, provided that the wall has been properly designed and good mortar is used



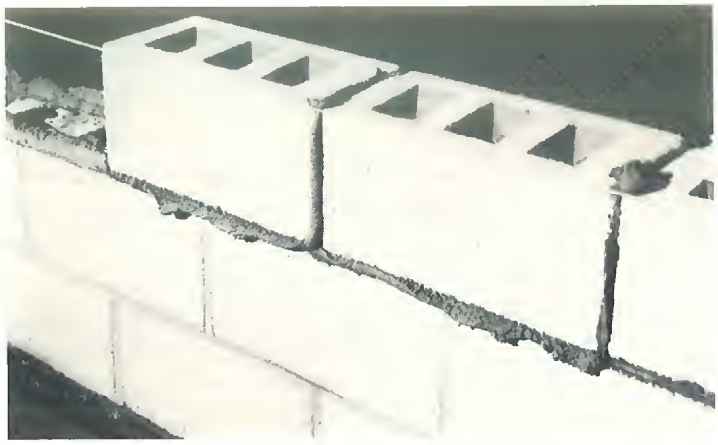
With block walls, face-shell bedding is preferred because it improves the ability of the wall to resist the passage of water.

• FULL FACE-SHELL BEDDING FOR BLOCK

Face-shell bedding should be used in laying up concrete block except where good practice calls for full bedding. For the first course on the foundation, for pilasters, and where maximum strength is required, full mortar bedding should be used, that is, mortar is spread on the cross webs of the block as well as the face shells. In face-shell bedding, mortar should be spread fully to cover both the face shells of the block so that excess mortar will be squeezed out of the joints on both sides of the face shells when a block is laid in position.



Head joints for block should be full of mortar on both the inner and outer edges.

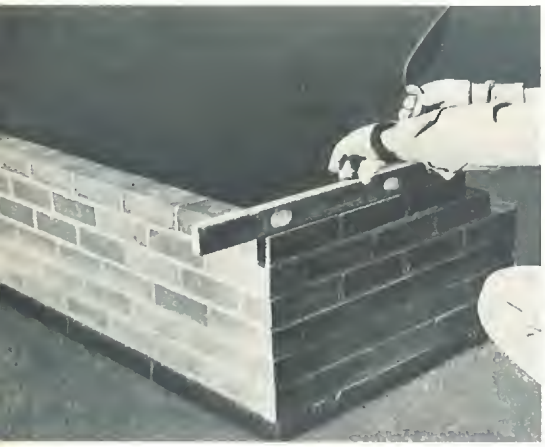


Enough mortar should be used so that excess mortar will be squeezed out on both sides of the face shells.

All edges of the closure block should be buttered before it is lowered into position.

In placing a closure block, butter mortar generously on inside and outside edges of the blocks in place. Face shells of the bed should also be full of mortar.

ALIGNMENT



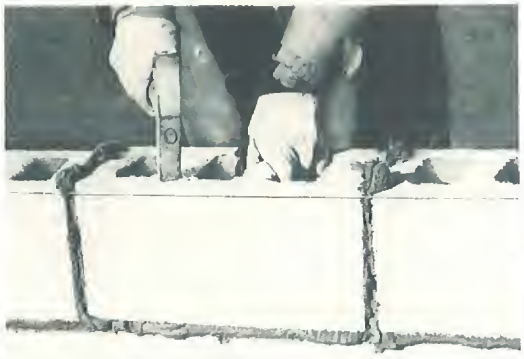
Once a brick has been placed, any tapping into alignment with the trowel must be done while the mortar is still fresh and soft. Once the mortar begins to stiffen, any attempt to re- align the brick may break the bond between the brick and mortar and destroy the water tightness of the wall at this point. If it should become necessary to shift the position of a brick after the mortar begins to set, both the brick and mortar should be removed from the wall and the brick relaid with fresh mortar.

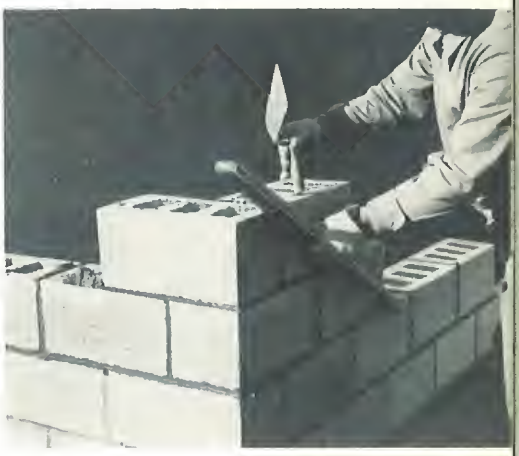
TOOLING

Tooling of the mortar joints is an excellent practice to help assure weather-tight walls. When parging or plastering is not done, tooling is essential, and it is an excellent added precaution against water penetration even where the wall is plastered. Tooling is best done with a rounded tool that will make a concave joint — this packs the mortar tightly against both masonry units, thereby producing joints highly resistant to passage of water.

PLASTERING

An excellent way to improve the resistance of any wall to water penetration is to plaster mortar on the back facing, or to plaster the face of the back-up wall units, depending upon which is laid first. The mortar used in plastering is the same as that used in laying wall units. Usual thickness for plastering is from ¼″ to ⅜″. Before plastering is begun, mortar joints must be struck smooth. The use of plastering is recommended practice, and its effectiveness has been proved by field experience.





It is generally necessary to adjust alignment of blocks after placing. Tapping a block into alignment *after the mortar has stiffened* is a serious infraction of the rules of good workmanship. If the mortar bond is thus broken, water can penetrate the wall at this point. For good block work, Atlas Mortar Cement provides sufficient body to the mortar to hold the weight of the block, and at the same time, the mortar retains sufficient plasticity to allow the block to be tapped easily into alignment.

Unless otherwise specified, all exterior joints on concrete block masonry should be tooled. A rounded tool slightly larger than the joint is preferred. Tooling of joints should not be considered a remedy for incomplete filling of joints. On block walls, architectural design may favor tooling only the horizontal joints, with the vertical joints being trowelled flush. This is especially popular where the wall is to be finished with cement paint.

An exterior coating of mortar is frequently plastered below the ground level of concrete block basement walls to make them more waterproof. Walls are plastered on the earth side from top of footing to 6″ above the ground level with two ¼″ coats applied according to procedure under STUCCO on the following page. When second coat is properly cured, it should be brushed with an asphalt primer and two coats of hot bituminous material.

STUCCO


PRE-WETTING CONCRETE MASONRY WALL


APPLYING FIRST COAT


FIRST COAT SCRATCHED FOR BETTER BOND WITH NEXT COAT

Atlas Mortar Cement can cut costs in stucco work because it saves considerable time by eliminating prolonged waiting periods for curing and drying between application of coats.

In applying stucco directly over concrete masonry walls, units should be well cured and dried to eliminate shrinkage. However, before application, the surface should be evenly pre-wet, but not saturated, by dashing with a brush or with a light water spray.

Monolithic concrete surfaces should be prepared by roughening with a bush hammer, or acid washing with a 1:6 solution of muriatic-acid. Perhaps the most effective and economical bonding key may be obtained by wetting the surface, and when the wall is damp but not wet, dashing a 1:1 grout of Atlas Mortar Cement and sand evenly over the surface. Moist curing of the key grout for a day is just as important as curing the stucco.

Stucco proportions of Atlas Mortar Cement to sand, by volume damp and loose, are as follows: For first (or scratch) coats applied over metal lath, a 1:2½ mix with all sands from fine to coarse; for second (or brown) coats and finish coats on metal lath, and for all coats applied directly over masonry or concrete (scratch, brown and finish) the proportions are: with fine sand, 1:4; with medium sand, 1:3½; with coarse sand, 1:3.

The second coat can and should be applied as soon as the first coat has set up sufficiently to carry the weight. This is usually within 3 hours, depending upon temperature and humidity, since low temperature tends to slow setting and hardening. The third or finish coat should also be applied as soon as possible after the second coat hardens, usually the next morning. On metal lath, the interval should not be more than 24 hours. However, where coloring pigment is used in the finish coat, the brown coat is allowed to dry.

Rapid follow-up of successive coats helps obtain a strong bond and control shrinkage. If the undercoats are allowed to dry, they should be thoroughly and evenly wet with a water spray to provide uniform color in the finish coat.

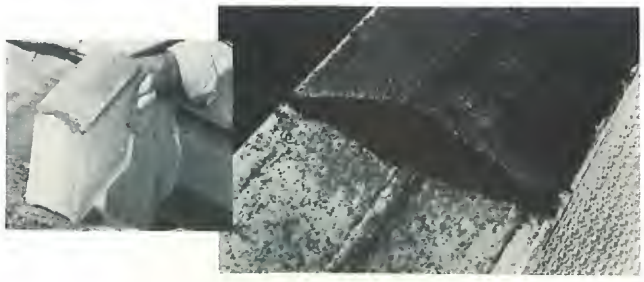
The first coat is applied about ⅜″ thick. On reasonably true masonry and monolithic concrete, 2-coat work may be satisfactory, in which case the finish coat is about ¼″ thick. For 3-coat work, the thickness of the second coat is kept to a minimum that will permit scratching, and finish coats are about ⅛″ thick.

TILE SETTING

Atlas Mortar Cement also provides an excellent bed for setting wall tile.

GLASS BLOCK

To insure full mortar joints with glass block the mortar should be crowned as illustrated at the right.



Available . . .

STANDARD SPECIFICATIONS FOR MASONRY CEMENT

The American Society for Testing Materials and the Federal Government have issued national specifications for masonry cement. These are: *Standard Specifications for Masonry Cement, ASTM Designation: C 91;* and *Federal Specification, Cement; Masonry SS-C-181.* The latest issue of these specifications may be obtained from any of the Universal Atlas Cement Company offices listed on the back cover of this booklet.

QUOTES From Men who Use Atlas Mortar Cement

"I have used Atlas Mortar Cement almost exclusively since it was first introduced to the trade. I prefer it because of its plasticity, its high yield and lack of shrinkage." Claude C. Carson, Mason Contractor, Corsicana, Texas.

"This was my first experience with Atlas Mortar Cement for winter construction and it proved very satisfactory. Summer or winter Atlas Mortar is my choice." Hjalmar Brostrom, General Construction Superintendent, Minneapolis, Minnesota.

"We have used Atlas Mortar Cement on our jobs for the past 10 years. On job after job, we continue to get a stronger bond and a greater yield with Atlas Mortar Cement. Our labor costs are also sharply reduced when using Atlas Mortar Cement." Paul Woodcox, General Contractor, South Bend, Indiana, shown left with his son, Dale.

"I have been using Atlas Mortar Cement for five years, and can say that for best results Atlas Mortar Cement is my choice. I prefer Atlas Mortar Cement and my masons have the same preference. We have always obtained a good performance record with Atlas Mortar Cement. It works and spreads like butter . . . makes our work easier." Emel Zancanaro, Masonry Contractor, Gary, Indiana.

"In my capacity as Field Superintendent on this job, we have used approximately 10,000 bbls. of Atlas Mortar Cement. Our masons like to use it because of its easy workability, easy troweling and the strong bond it makes. We find that, when we give our men materials that they like to work with, our costs are lower." Frank J. Braun, Field Superintendent, Pittsburgh, Pa.

"Frankly we were skeptical of changing to Atlas Mortar Cement as we doubted what your representative told us could be true. After trying Atlas Mortar we found that our masons were better satisfied . . . they liked the plasticity, and the way it spreads under the trowel. On our present project . . . we are especially pleased with the color . . . we find that Atlas Mortar blends well with any color brick . . . I cannot say enough for Atlas Mortar Cement." D. W. Richardson, General Contractor, Scranton, Pennsylvania.

"Our Masonry foreman and all of his men were very complimentary of yield and workability of the Atlas Mortar Cement used on this job. During the cold months it allowed them to lay for a longer period and in the final wind-up gave us a very clean, hard-surfaced finish." R. N. Hoar, General Contractor, Birmingham, Alabama.

"I have used Atlas Mortar Cement for years. It has always been tops with me." Joseph Pintavalle, General Contractor, Schenectady, N. Y.

"We, as general contractors, selected Atlas Mortar Cement because of its excellent water retention and plasticity values." George E. Baumeister, General Contractor, St. Paul, Minnesota, shown with his brothers, Arthur and Walter.

"We like Atlas Mortar Cement because we can get good production with it and still give our customer a first class job. Its excellent working qualities help the mason to get the well-filled joints that a water-tight wall demands." Oscar Schober, Masonry Contractor, Thiensville, Wisconsin.

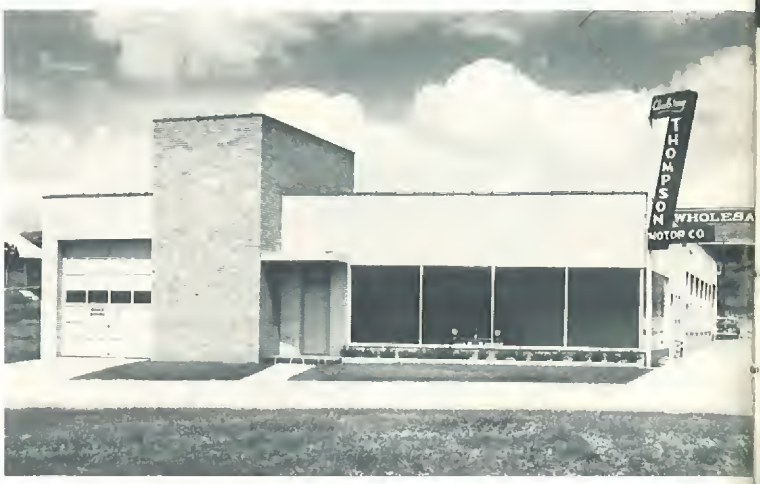
"We've been building houses for 26 years and have found Atlas Mortar Cement to make the best mortar by far. We will use nothing but Atlas Mortar Cement on our jobs . . . we prefer Atlas Mortar because it sets up just right, not too fast and not too slow and spreads and trowels easily . . . good water retention . . . no hair cracks in mortar joints . . . excellent bonding value . . . uniform consistency . . . good, uniform color . . . more block and brick laid per bag." Joseph E. Short, General Contractor, Donora, Pennsylvania.

"I would like to commend your product Atlas Mortar Cement, and recommend it to other contractors. It is easy to work with and its lasting plasticity improves bonding. The finished masonry is worth noticing when Atlas Mortar Cement has been used." Frank Scheck, General Contractor, Chicago, Illinois.

"We approved the use of Atlas Mortar Cement . . . are pleased with the appearance . . . and feel sure that the characteristics of the mortar . . . help the mason lay up a clean smooth job. We assure you it is a pleasure for us to have a masonry job about which we can say nice things." E. B. Van Keuren, Architect, Birmingham, Ala.

TYPICAL

Church & School Building, Whiting, Indiana
Architect: Kenneth R. Vaughn, Hammond, Indiana
General Contractor: Roy Osborne, Hammond, Indiana

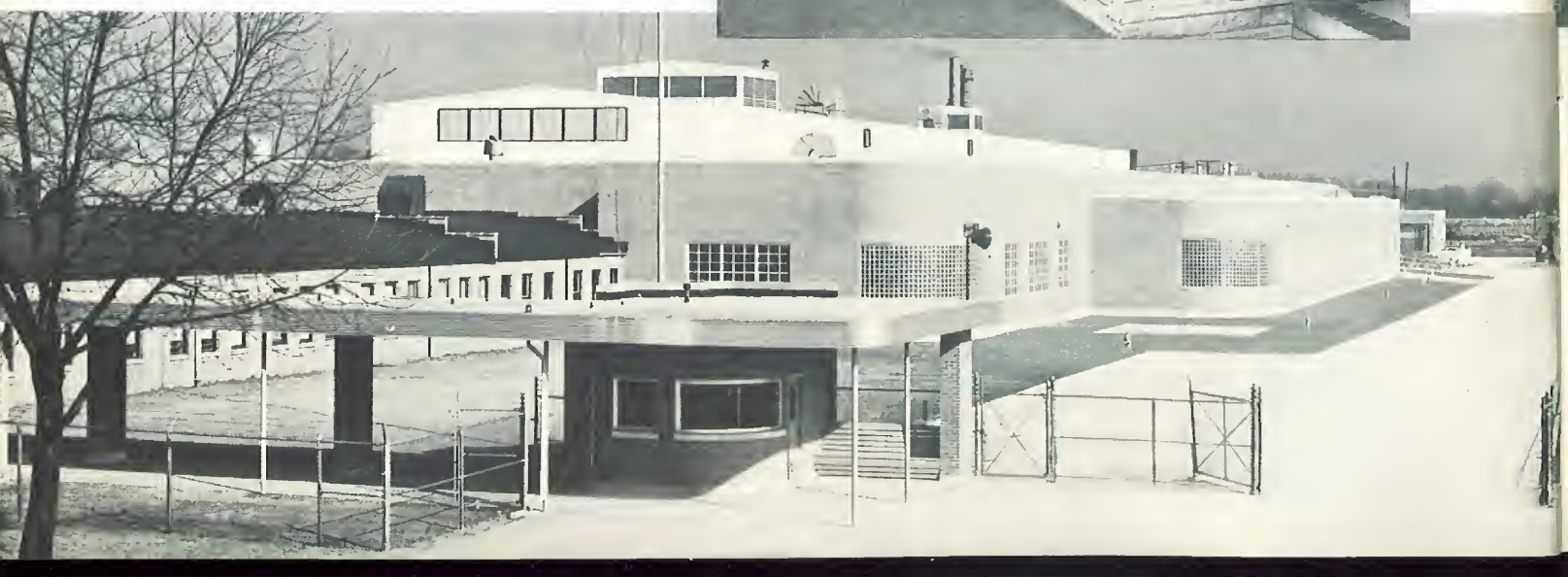


Commercial Building, Tyler, Texas
General Contractor: Hobart Plunkett, Tyler, Texas

Trav-L-Lodge, Dallas, Pa.
General Contractor: Hughes Bros., Luzerne, Pa.

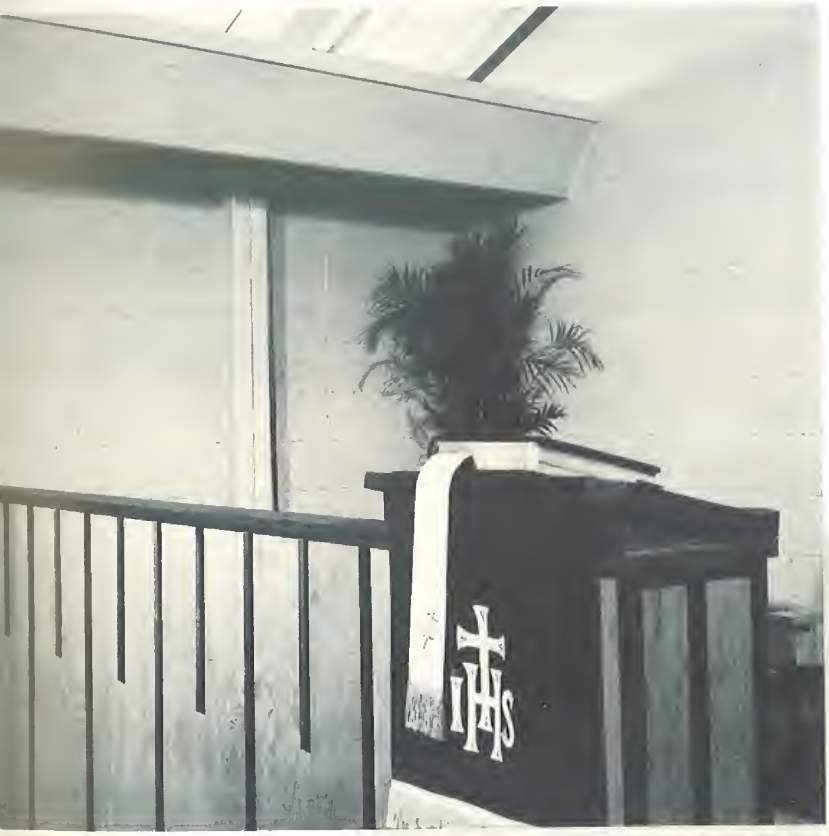
Residence of A. D. McMullan, General Contractor, Corsicana, Texas
Mason Contractor: Claude C. Carson, Corsicana, Texas

RCA Building, Marion, Indiana
General Contractor: Sollitt Construction Co., South Bend, Ind.



JOBS

High School Gymnasium, Chicago, Ill.
General Contractor: Van Etten Bros., Chicago, Ill.
Architect: A. F. Moratz, Bloomington, Ill.
Concrete Masonry used for interior facing.
Inset shows ashlar block being laid on above gymnasium.

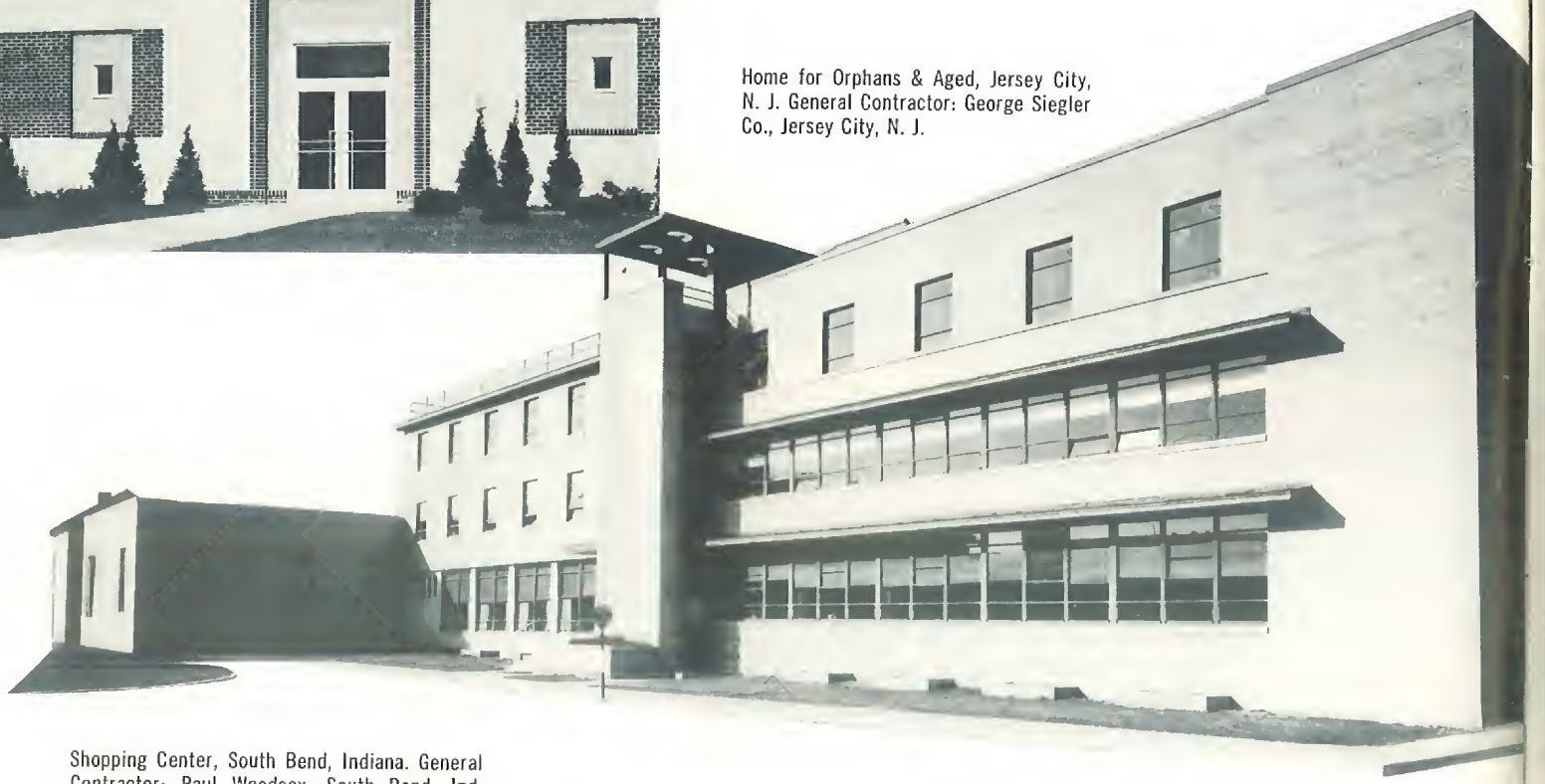


Church, Greenville, S. C., Concrete Masonry Interior Finish.
General Contractor: Justice-Jones Construction Co., Greenville, S. C.
Architect: Robert Longstreet & Associates, Greenville, S. C.

Apartment Buildings, Hammond, Ind. Owner: Calumet Construction Corp., Hammond, Ind. Mason Contractor: Emel Zancanaro, Gary, Indiana.

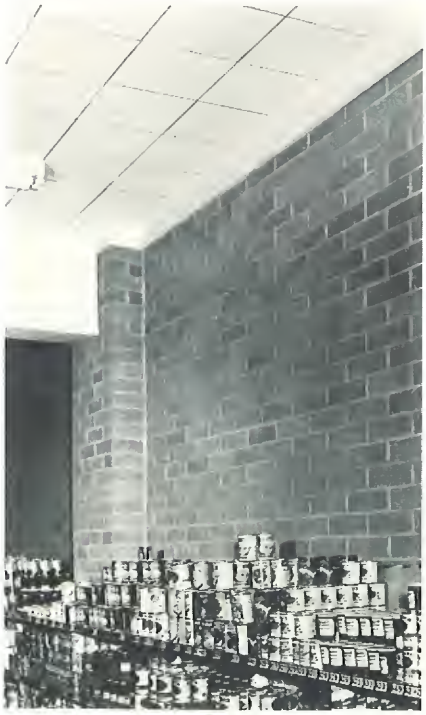
TYPICAL

Office & Warehouse, St. Paul, Minn. Mason Contractor: Wm. Baumeister Construction Co., St. Paul, Minn. Architect: Arthur F. Larberg, Kansas City, Missouri.



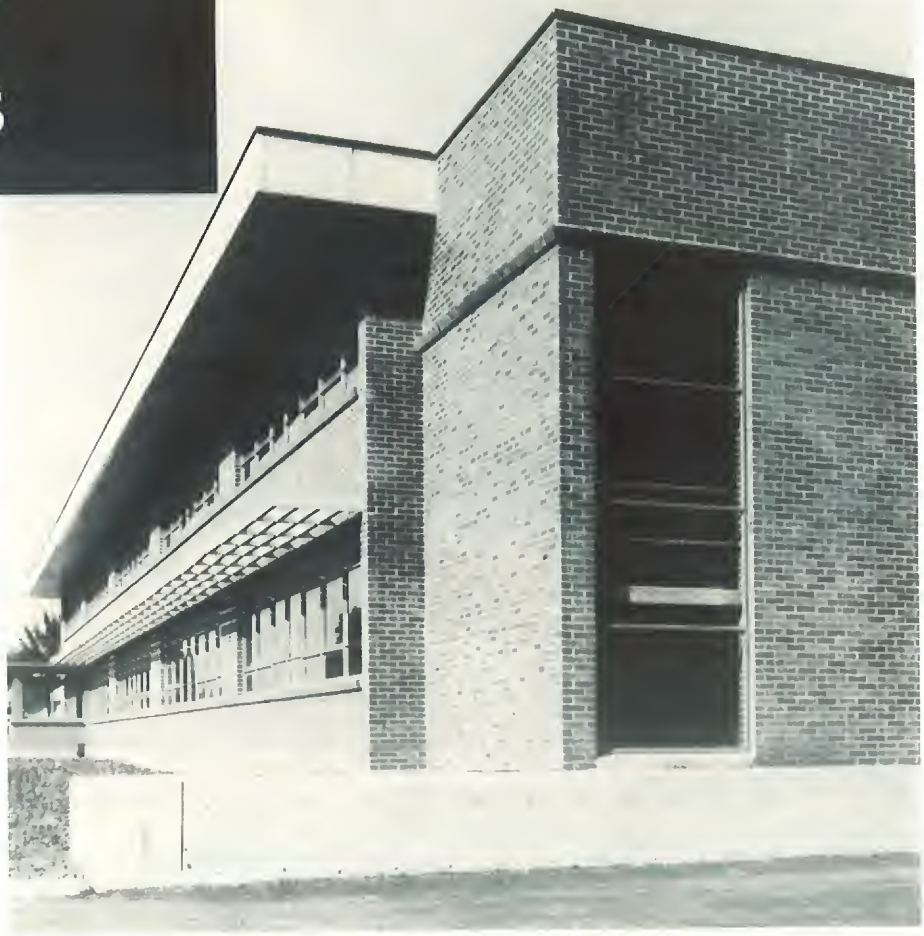
Home for Orphans & Aged, Jersey City, N. J. General Contractor: George Siegler Co., Jersey City, N. J.

Shopping Center, South Bend, Indiana. General Contractor: Paul Woodcox, South Bend, Ind. Mason Contractor: Hugh M. Lee, Niles, Michigan. Architect: Charles T. Donegan, South Bend, Ind. Brikcrete masonry partition walls form the interior finish.



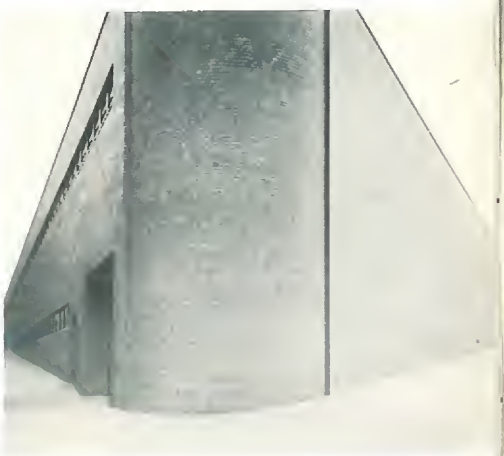
Residence, Harrington Park, N. J.
General Contractor: Robert Grasing, Woodcliff Lake, N. J. Concrete block masonry painted with white cement. Vertical joints are trowelled flush and horizontal joints tooled to produce attractive effect and contrast with field stone.

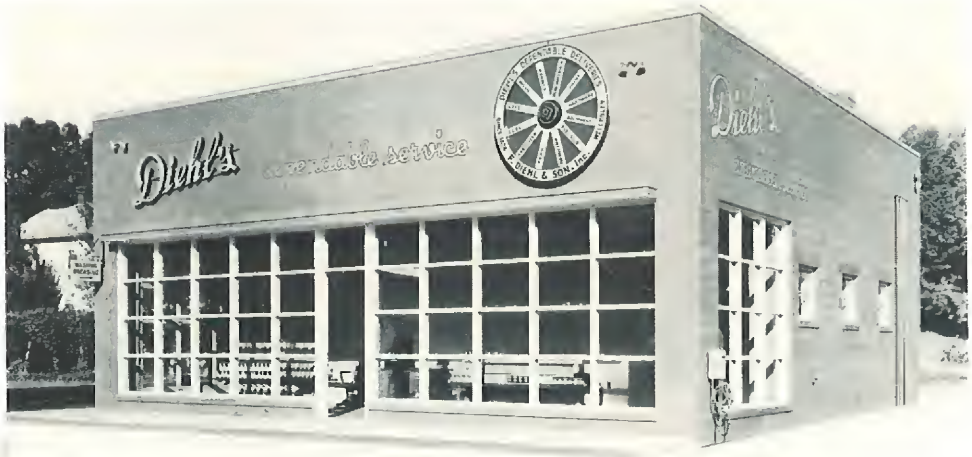
JOBS



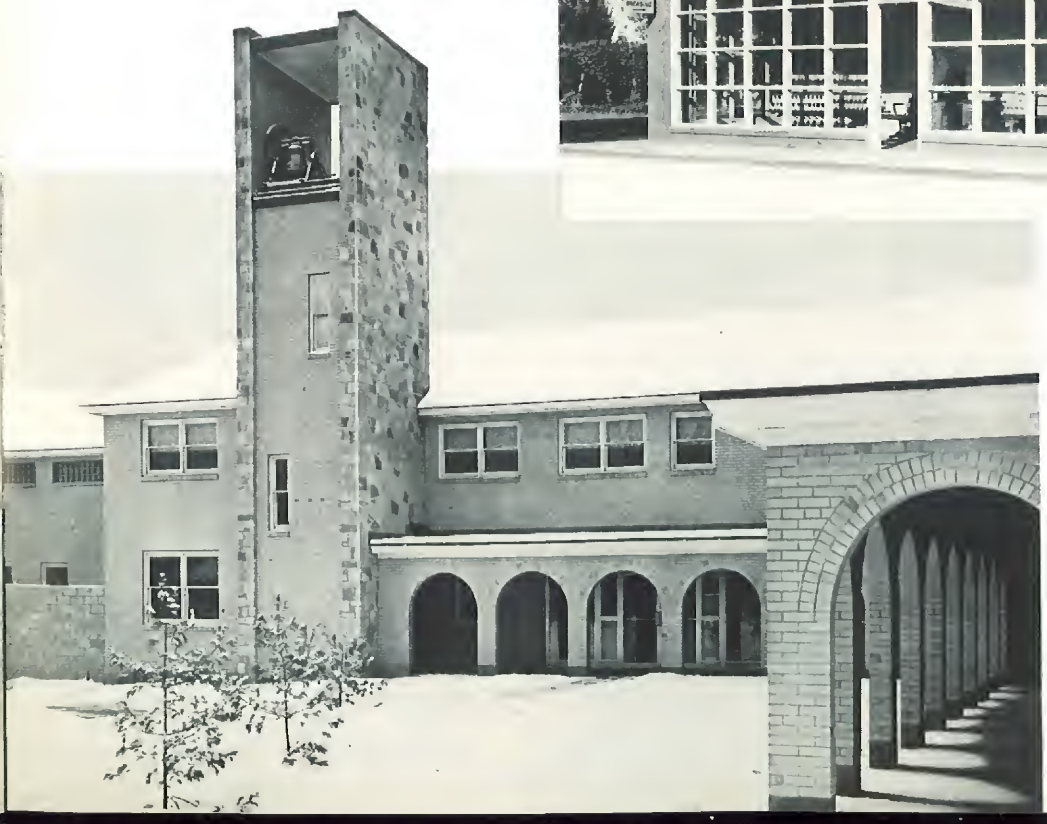
Junior High School, Arlington Heights, Ill. General Contractor: J. Emil Anderson & Son, Inc., Chicago. Architect: Ganster & Hennighausen, Waukegan, Ill.

Manufacturing Plant, New York, N. Y. General Contractor: Robert Glenn, Inc., New York City. Architect: Walter Cory, New York City.





Service Station, Wellesley, Mass. General Contractor: E. T. Madden & Son, Wellesley, Mass. Mason Contractor: Emanuel Indresano, Wellesley, Mass.



Monastery Building, Concord, New Hampshire. General Contractor: Brideau Construction Co., Berlin, New Hampshire.

TYPICAL JOBS

State Hospital Building, Torrance, Pa. Contractor: Navarro Corporation, Pittsburgh, Pennsylvania

Construction Company's Building, Schenectady, N. Y. Contractor-Owner: Joseph Pintavalle, Schenectady, N. Y. Concrete cast-stone masonry front; concrete block masonry sides and rear.

Fire Station, Roxbury, Mass. General Contractor: Edward R. Marden Corp., Brookline, Mass. Architect: Markus and Nocka, Boston, Mass., and R. B. Cutler, Associate.

School, Cedarburg, Wisconsin. Mason Contractor: William Schober & Son, Thiensville, Wisconsin. Architects: Brimeyer, Grellinger & Rose, Milwaukee, Wisconsin.

Warehouse, Dayton, Ohio. General Contractor: B. G. Danis, Inc., Dayton, Ohio. Mason Contractor: F. E. Longstreth Co., Dayton, Ohio. Architect: Lockwood Greene Engineers, New York, N. Y.

REFERENCE TABLES

1 Atlas Mortar CEMENT and SAND Required

MIX BY VOLUME	FOR 1 CUBIC YARD OF MORTAR			FOR 100 CUBIC FEET OF MORTAR		
	ATLAS MORTAR CEMENT Bags	SAND*		ATLAS MORTAR CEMENT Bags	SAND*	
		Cu. Ft.	Cu. Yd.		Cu. Ft.	Cu. Yd.
1:2	12.6	25.2	.93	46.7	93.4	3.46
1:2½	10.6	26.5	.98	39.3	98.2	3.64
1:3	**9.0**	**27.0**	**1.00**	**33.3**	**99.9**	**3.70**
1:3½	7.8	27.3	1.01	28.9	101.2	3.74
1:4	6.9	27.6	1.02	25.6	102.4	3.79

*Based on one cubic foot of damp, loose sand containing 80 lbs. of dry sand.

●Recommended proportions for general masonry use.

2 Materials for BRICK* Masonry

WALL THICKNESS	PER 100 SQ. FT. OF WALL SURFACE				PER 1000 BRICKS		
	NUMBER OF BRICKS	CU. FT. OF MORTAR	1:3 MIX BY VOLUME		CU. FT. OF MORTAR	1:3 MIX BY VOLUME	
			ATLAS MORTAR CEMENT Bags	SAND** Damp, Loose Cu. Ft.		ATLAS MORTAR CEMENT Bags	SAND** Damp, Loose Cu. Ft.
4"	616	7.2	2.4	7.2	11.7	3.9	11.7
8"	1232	18.6	6.2	18.6	15.0	5.0	15.0
12"	1848	30.0	10.0	30.0	16.2	5.4	16.2
16"	2464	41.4	13.8	41.4	16.8	5.6	16.8

*Standard Size Brick—2¼"x3¾"x8". All joints assumed to be ½" thick.

**Based on one cubic foot of damp, loose sand containing 80 lbs. of dry sand. No allowance for waste.

3 Wall Area per 1000 BRICKS* Sq. Ft.

WIDTH OF JOINT	THICKNESS OF WALL IN INCHES			
	4"	8"	12"	16"
¼"	143	71.6	47.7	35.8
⅜"	153	76.4	50.9	38.2
½"	162	81.2	54.1	40.6
⅝"	172	86.1	57.4	43.1
¾"	182	91.2	60.8	45.6

*Standard size brick 2¼"x3¾"x8".

4 BRICKS* per 100 Sq. Ft. of Solid Wall

WIDTH OF JOINT	THICKNESS OF WALL IN INCHES			
	4"	8"	12"	16"
¼"	698	1396	2095	2793
⅜"	655	1310	1965	2620
½"	616	1232	1848	2464
⅝"	581	1161	1742	2322
¾"	549	1097	1646	2194

CONCRETE MASONRY Mortar Requirements for 100 sq. ft. of Wall

5

Weights and Quantities

ACTUAL UNIT SIZES WIDTH x HEIGHT x LENGTH INCHES	NOMINAL WALL THICKNESS INCHES	NO. OF UNITS	AVERAGE WEIGHT OF FINISHED WALL		MORTAR ‡ Cu. Ft.	1:3 MIX BY VOLUME	
			Heavyweight Aggregates Lbs.*	Lightweight Aggregates Lbs.†		ATLAS MORTAR CEMENT Bags	SAND§ Damp, Loose Cu. Ft.
3⅝x3⅝x15⅝	4	225	3050	2150	4.3	1.43	4.3
5⅝x3⅝x15⅝	6	225	4550	3050	4.3	1.43	4.3
7⅝x3⅝x15⅝	8	225	5700	3700	4.3	1.43	4.3
3¾x5x11¾	4	221	3000	2150	3.7	1.23	3.7
5¾x5x11¾	6	221	4500	3050	3.7	1.23	3.7
7¾x5x11¾	8	221	5650	3700	3.7	1.23	3.7
3⅝x7⅝x15⅝	4	112.5	2850	2050	2.6	0.87	2.6
5⅝x7⅝x15⅝	6	112.5	4350	2950	2.6	0.87	2.6
7⅝x7⅝x15⅝	8	112.5	5500	3600	2.6	0.87	2.6
11⅝x7⅝x15⅝	12	112.5	7950	4900	2.6	0.87	2.6

*Actual weight within ± 7% of average weight.

†Actual weight within ± 17% of average weight.

‡With face-shell mortar bedding. Mortar quantities include 10% allowance for waste.

§Based on one cubic foot of damp, loose sand containing 80 lbs. of dry sand.

Table based on ⅜-inch mortar joints.

Actual weight of 100 sq. ft. of wall can be computed by formula W (N) + 150 (M) where:

W = actual weight of a single unit

N = number of units for 100 sq. ft. of wall

M = cu. ft. of mortar for 100 sq. ft. of wall

Adapted from P.C.A. publication "Concrete Masonry Handbook."

Mortar Materials for 100 CONCRETE MASONRY Units

6

ACTUAL UNIT SIZES WIDTH x HEIGHT x LENGTH INCHES	NOMINAL WALL THICKNESS INCHES	MORTAR Cu. Ft.	1:3 MIX BY VOLUME	
			ATLAS MORTAR CEMENT Bags	SAND* Damp, Loose Cu. Ft.
3⅝x3⅝x15⅝	4	1.9	0.63	1.9
5⅝x3⅝x15⅝	6	1.9	0.63	1.9
7⅝x3⅝x15⅝	8	1.9	0.63	1.9
3¾x5x11¾	4	1.7	0.57	1.7
5¾x5x11¾	6	1.7	0.57	1.7
7¾x5x11¾	8	1.7	0.57	1.7
3⅝x7⅝x15⅝	4	2.3	0.77	2.3
5⅝x7⅝x15⅝	6	2.3	0.77	2.3
7⅝x7⅝x15⅝	8	2.3	0.77	2.3
11⅝x7⅝x15⅝	12	2.3	0.77	2.3

*Based on one cubic foot of damp, loose sand containing 80 lbs. of dry sand.

Table based on ⅜" mortar joints, with face shell mortar bedding. Mortar quantities include 10% allowance for waste.

7 CONCRETE BLOCK Quantities 16" Units per Course, Solid Walls

Size of Bldg. in Feet	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
2	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61
4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64
6	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67
8	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70
10	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70	73
12	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70	73	76
14	22	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70	73	76	79
16	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70	73	76	79	82
18	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85
20	31	34	37	40	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88
22	34	37	40	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91
24	37	40	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94
26	40	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97
28	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100
30	46	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100	103
32	49	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100	103	106
34	52	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100	103	106	109
36	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100	103	106	109	112
38	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100	103	106	109	112	115
40	61	64	67	70	73	76	79	82	85	88	91	94	97	100	103	106	109	112	115	118
42	64	67	70	73	76	79	82	85	88	91	94	97	100	103	106	109	112	115	118	121
44	67	70	73	76	79	82	85	88	91	94	97	100	103	106	109	112	115	118	121	124
46	70	73	76	79	82	85	88	91	94	97	100	103	106	109	112	115	118	121	124	127
48	73	76	79	82	85	88	91	94	97	100	103	106	109	112	115	118	121	124	127	130
50	76	79	82	85	88	91	94	97	100	103	106	109	112	115	118	121	124	127	130	133
52	79	82	85	88	91	94	97	100	103	106	109	112	115	118	121	124	127	130	133	136
54	82	85	88	91	94	97	100	103	106	109	112	115	118	121	124	127	130	133	136	139
56	85	88	91	94	97	100	103	106	109	112	115	118	121	124	127	130	133	136	139	142
58	88	91	94	97	100	103	106	109	112	115	118	121	124	127	130	133	136	139	142	145
60	91	94	97	100	103	106	109	112	115	118	121	124	127	130	133	136	139	142	145	148

*Explanation: To find the number of block for any building always use outside measurements. A basement 22 feet by 32 feet, for example, would require 79 block for one course all around. Multiply 79 by the number of courses needed. Thus a 10-course basement would require a total of 790 block for the solid wall, from which deductions should be made for windows and doors. If any dimension is an odd number such as 22 feet by 31 feet see table for nearest smaller size; for example 22 feet by 30 feet, and add 1½ block per row.

8 Mortar Materials for TILE per 100 sq. ft. of Wall Covering 1 Bed and 1 End Joint

SIZE OF TILE	CELLS LAID . . .	MORTAR Cu. Ft.	1:3 MIX BY VOLUME	
			ATLAS MORTAR CEMENT Bags	SAND* Damp, Loose Cu. Ft.
2x12x12	Horizontal	1.30	.43	1.30
3x12x12	"	1.60	.53	1.60
4x12x12	"	2.00	.67	2.00
6x12x12	"	2.60	.87	2.60
8x12x12	"	3.25	1.08	3.25
10x12x12	"	4.00	1.33	4.00
12x12x12	"	5.00	1.67	5.00
10x8x16	Building block	5.75	1.92	5.75
6x12x8	"	3.50	1.17	3.50
8x12x8	"	5.80	1.93	5.80

Adapted from Walker's "The Building Estimator's Reference Book" (1954).

*Based on one cubic foot of damp, loose sand containing 80 lbs. of dry sand.

9 GLASS BLOCK Materials Required per 100 Sq. ft. of Wall Based on ¼" Joint

SIZE OF BLOCK	NUMBER OF BLOCK	MORTAR† Cu. Ft.	1:3 MIX BY VOLUME	
			ATLAS MORTAR CEMENT Bags	SAND* Damp, Loose Cu. Ft.
5¾x5¾x3⅞	400	5.00	1.67	5.00
7¾x7¾x3⅞	225	3.60	1.20	3.60
11¾x11¾x3⅞	100	2.33	.78	2.33

Adapted from Walker's "The Building Estimator's Reference Book" (1954).

*Based on one cubic foot of damp, loose sand containing 80lbs.of dry sand. † Includes 10% for waste.

Mortar Materials for 1000 GLASS BLOCKS Based on ¼" Joints

10

SIZE OF BLOCK	AREA COVERED Sq. Ft.	MORTAR † Cu. Ft.	1:3 MIX BY VOLUME	
			ATLAS MORTAR CEMENT Bags	SAND * Damp, Loose Cu. Ft.
5¾x5¾x3⅞	250	12.50	4.17	12.50
7¾x7¾x3⅞	445	16.00	5.33	16.00
11¾x11¾x3⅞	1000	23.30	7.77	23.30

Adapted from Walker's "The Building Estimator's Reference Book" (1954).

*Based on one cubic foot of damp, loose sand containing 80lbs. of dry sand. † Includes 10% for waste.

STUCCO Materials Required for 100 Sq. Ft. of Wall

11

THICKNESS	MORTAR Cu. Ft.	1:2		1:2½		1:3		1:3½	
		ATLAS MORTAR CEMENT Bags	SAND* Cu. Ft.	ATLAS MORTAR CEMENT Bags	SAND* Cu. Ft.	ATLAS MORTAR CEMENT Bags	SAND* Cu. Ft.	ATLAS MORTAR CEMENT Bags	SAND* Cu. Ft.
¼"	2.08	.97	1.94	.82	2.05	.69	2.08	.60	2.10
⅜"	3.12	1.46	2.92	1.22	3.05	1.04	3.12	.90	3.15
½"	4.17	1.95	3.90	1.64	4.10	1.39	4.17	1.20	4.20
⅝"	5.21	2.44	4.88	2.05	5.13	1.74	5.21	1.51	5.29
¾"	6.25	2.92	5.84	2.45	6.13	2.08	6.25	1.81	6.34
1"	8.33	3.89	7.78	3.27	8.13	2.78	8.33	2.41	8.44

*Based on 1 cubic foot of damp, loose sand containing 80lbs. of dry sand. No allowance has been made for waste.

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